RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Algebraic Coding Theory)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Uniit – 1

The Coding Problem. Block Codes, Group Codes, Error-Detecting and Error-Correcting Codes, Generator and parity check matrices, Polynomial codes, Hamming codes, Linear codes, Dual Codes, Weight distribution of dual codes. New codes obtained from the given codes.

Unit - 2

Finite Fields, BCH Codes, Bounds on Minimum Distance for Block Codes: Plotkin bound, Hamming or Sphere-Packing Bound, Varshamov-Gilbert-Sacks Bound. Bounds for Burst Error-Detecting and Correcting Codes.

Unit - 3

Hadamard matrices and Hadamard codes. Maximum Distance Separable (MDS) codes, Generator and parity check matrices of MDS codes, Weight distribution of MDS codes.

Text Books: -

1. L.R. Vermani, Elements of Algebraic Coding Theory, Chapman and Hall Mathematics Series, 1996.
2. Raymond Hill, A First Course in Coding Theory, Oxford University Press, 1986.
3. W. Wesley Peterson and E.J. Weldon, Jr., Error-Correcting Codes. M.I.T. Press, Cambridge Massachuetts, 1972.
4. Elwyn R. Berlekamp, Algebraic Coding Theory, World Scientific Publishing Company, 2015.
5. F.J. MacWilliams and N.J.A. Sloane, The Theory of Error-Correcting Codes, North-Holland, 1983.

RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Advanced Functional Analysis)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - 1

Contraction mapping theorem and its applications to differential equations, integral equations and system of linear equations. Equicontinuity, Arzla-Ascoli theorem and its application to differential equations. Weierstrass's approximation theorem, Stone-Weierstrass's approximation theorem, Semicontinuity and its applications to Arclength.

Unit - II

Analytic vector valued functions, Definition of normed and Banach algebras with identity. Regular points and spectrum. Compactness of spectrum. Resolvent function and its analyticity in the set of regular points. Gelfand's theorem about isomorphism between Banach algebras and complex numbers. Spectral radius and the spectral mapping theorem for polynomials. Ideals and Maximal ideals in commutative Banach algebras with identity. The set C(M) of complex functions on the set M of maximal ideals in a Banach algebra. Gelfand representation for algebras with identity.

Unit - III

Bilinear mappings, Bounded bilinear mappings, Sesquilinear mappings, Hermitian form, Bounded sesquilinear mappings, Bounded sesquilinear forms in Hilbert space.

Text Books: -

1. Bachman, G. and Lawrerie Narici, Functional Analysis, Academic Press.
2. Goffman, C. and G. Pedrick, First Course in Functional Analysis .
3. Berberian, S.K., Introduction to Hilbert Spaces, (Chelsea Publishing Co. N.Y.).
4. Babu Ram, Metric Spaces, Vinayaka Publications, New Delhi.

RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Fixed Point Theory)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Banach Contraction Principle (BCP) and some consequences of contraction principle, A converse of contraction principle, some other extensions of BCP for single valued mappings as given in Section 2.4 of the Book at the Sr. No. 3., Retraction mappings, locally contractive maps, -chain, (-k) uniformly locally contractive maps, contractive and -contractive maps, Edelstein theorems for (-k) uniformly locally contractive, contractive and -contractive maps. Contractive mappings as defined by Boyd and Wong, fixed points of local power contraction mapping. Caristi fixed point theorem and its generalization.

Unit - II

Nonexpansive mappings, Some general properties of nonexpansive mappings. Approximation of fixed points of nonexpansive and generalized nonexpansive mappings. Fixed point property, Brouwer's fixed point theorems and applications, Schauder's fixed point theorem and consequences of Schauder's theorem, Schauder Tychonoff and Krsnoselkii's fixed point theorems.

Unit - III

Some iterative methods for fixed points, The LE property and AF property for nonlinear operators, Demiclose principle, nearly Lipchitzian mappings. Asymptotically κ-strict Pseudocontractive in the intermediate sense, Picard iterative method, Mann iterative method, Ishikawa iterative method, Halpern iterative method, CQ iteration method and Browder iterative method for finding fixed points.

Text Books: -

1. Istratescu, V.I., Fixed Point Theory: An Introduction, Mathematics and its applications, Springer, 2003.
2. Joshi, M.C. and Bose, R.K., Some Topics in Non-linear Functional Analysis, Wiley Eastern Limited, New Delhi (1985).
3. Saleh Almezel, Qamrul Hasan Ansari and Mohamed Amine Khamsi, Topics in Fixed Point Theory, Springer, 2014.

RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Theory of Linear Operators)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Spectral theory in normed spaces, resolvent set and spectrum, Spectral properties of bounded linear operators, Spectral radius of a bounded linear operator on a complex Banach space, Properties of resolvent and spectrum, Spectral mapping theorem for polynomials. Compact linear operators on normed spaces. Separability of range and spectral properties of compact linear operators on normed spaces, Operator equations involving compact linear operators, Theorems of Fredholm type, Fredholm alternative theorem, Fredholm alternative for integral equations. (Scope as in Chapter 7 and 8 of Book at Sr.No.1).

Unit - II

Spectral properties of bounded self-adjoint linear operators on a complex Hilbert space, Positive Operators, Square roots of a Positive Operator, Projection Operators, Spectral family, Spectral family of a bounded self-adjoint Linear Operator, Spectral representation of bounded Self-adjoint Linear Operators, Extension of the Spectral theorem to continuous functions, Properties of the spectral family of a bounded self-adjoint linear operator.(Scope as in Chapter 9 of Book at Sr.No.1)

Unit - III

Unbounded linear operators and their Hilbert-Adjoint Operators, Hellinger-Toeplitz theorem, Symmetric and self-adjoint linear operators, Closed linear operators and closures, Spectral properties of self-adjoint linear operators, Spectral representation of Unitary operators, Wecken's lemma, Spectral theorem for Unitary operators, Spectral representation of self-adjoint linear operators, Cayley transform, Spectral theorem for self-adjoint linear operators, Multiplication operator and differentiation operator. (Scope as in Chapter 10 of Book at Sr.No.1).

Text Books: -

1. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley and Sons, 1978.
2. P. R. Halmos, Introduction to Hilbert Space and the Theory of Spectral Multiplicity, Second Edition, Chelsea Pub. Co., New York, 1957.
3. N. Dunford and J. T. Schwartz, Linear Operator 3 Parts, Interscience / Wiley, New York, 1958-71.
4. G. Bachman and L. Narici, Functional Analysis, Academic Press, New York, 1966.

RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Algebraic Number Theory

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Algebraic numbers, algebraic integers, countability of set of algebraic numbers, Liouville's theorem and generalizations, transcendental numbers, algebraic number fields, Liouville's Theorem of Primitive elements, ring of algebraic integers, Theorem of Primitive Elements. (Chapter 3 of book at Sr. No. 1).

Unit - II

Norm and trace of an algebraic number, non-degeneracy of bilinear pairing, existence of an integral basis, Discriminant of an algebraic number field, Ideals in the ring of algebraic integers, explicit construction of integral basis, Sign of the discriminant, cyclotomic fields, calculation for quadratic and cubic cases. (Chapter 4 of book at Sr. No. 1)

Unit - III

Integral closure, Noetherian ring, characterizing Dedekind domains, fractional ideals and unique factorization, g.c.d. and L.C.M. of Ideals, Chinese remainder theorem, Dedekind's theorem, ramified and unramified extensions. Different of an algebraic number field, factorization in the ring of algebraic integers. (Chapter 5 of book at Sr. No. 1)

Text Books: -

1. Esmonde and M Ram Murty, Problems in Algebraic Number Theory, GTM Vol. 190, Springer Verlag, 1999.
2. Leveque, W.J., Topics in Number Theory Vols. I, III Addition Wesley.
3. Narasimhan and others, Algebraic Number Theory, TIFR Pamphlet No. 4
4. Pollard, H., The Theory of Algebraic Number, Carus Monogrpah No. 9, Mathematical Association of America.
5. Riebenboim, P., Algebraic Numbers Wiley Inter-science.

RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Advanced Solid Mechanics)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Non-Linear Theory: Deformation gradient tensor. Decomposition of a deformation stretch and rotation. Strain tensors. Strain-displacement relations. Principal stretches. Strain invariants. Length and angle changes. Deformation of volume and surface elements. Homogeneous deformation-dilation, simple extension, simple shear and plane strain. Material derivative. Velocity and acceleration fields. Principle of conservation of mass-equation of continuity. Principles of balance of linear and angular momentum. Equations of motion in spatial coordinates. Principle of conservation of energy. Piolo stresses. Equations of motion in material co-ordinates.

Unit - II

General Solution of the equilibrium equations: Papkovitch-Neuber solution. Lame's strain potential. Galerkin vector. Love's strain function. Applications to the solution of the Kelvin problem for an unbounded medium and the Bossiness problem for a semi-infinite medium.

Unit - III

Exact solution of some linear elastic problems: Spherical shell subject to internal and external pressures. Gravitating elastic sphere.

Unit - IV

Thermoelectricity: Generalized Hooke's law including the effects of thermal expansion, Thermoelastic Navier's equation, Thermal stresses in a long cylindrical shell and solid cylinder, Thermal stresses in a hollow spherical shell and solid spherical shell.

Text Books: -

1. Mal. A.K. and Singh, S.J., Deformation of Elastic Solids, Prentice Hall, 1991
2. Fung, Y.C., Foundations of Solid Mechanics.
3. S. Valliappan, Continuum Mechanics - Fundamentals, Oxford and IBH Publishing Co., 1981
4. I.S. Sokolnikoff- Mathematical Theory and Elasticity, Tata McGraw Hill, New Delhi, 1977
5. S. Saada, A.S. Elasticity: Theory and Applications, Pergaman Press, 1973

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Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Waves and Viscoelasticity)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Waves on Strings: Free vibrations of an infinite string. Reflection at a change of density. Reflection at a concentrated load. Strings of finite length-normal modes. String plucked at its mid-point. String with load at its mid-point. (Coulson: Waves, Secs. 13-23).

Unit - II

Lamb's Problem: A periodic line or normal point force acting on the surface of a semi-infinite elastic solid (formal solution only).

Unit - III

Liquid Waves: Types of liquid waves, Gravity waves, Particle path, Waves in deep water, Wave energy, Rate of transmission of energy for harmonic wave, Group velocity, Effect of surface tension, Stationary waves, Waves in a canal, rectangular tank, cylindrical tank. Complex potential for a simple harmonic progressive wave, Waves on the surface of a uniform stream, Waves at the interface between fluids and effect of surface tension, Circular waves.

Unit - IV

Viscoelasticity: Spring and dashpot. Maxwell and Kelvin models. Three parameters solid. Constitutive equations for generalized Maxwell and Kelvin models. Creep compliance and relaxation modulus. Hereditary integrals. Vibrations-complex compliance, dissipation, application to specific materials, the simple spring-mass system, forced vibrations. Stress-strain relations for viscoelastic body. Correspondence principle and its application to the deformation of a viscoelastic thick-walled tube in plane strain. (Relevent Sections of Flugge's book "Viscoelasticity")

Text Books: -

1. Coulson, C.A., Waves, Longman.
2. Flugge, W., Viscoelasticity.
3. Fung, Y.C., Foundations of Solid Mechanics.
4. Besant, W. H. and Ramsey, A. S., A Treatise on Hydromechanics.

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Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Reliability Theory)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Reliability and Quality. Failure Data Analysis: Failure data, Failure density, Failure rate. Some Important distributions: Exponential, Rayleigh, Weibull, Gamma and Lognormal distributions. Laplace and Stieltjes transforms and convolutions. Component Reliability and Hazard Models: Component reliability from test data, mean time to failure (MTTF), Mean time between failures (MTBF), Time dependent hazard models, Bath-Tub Curve.

Unit - II

System Reliability Models: Systems with components in series, Systems with parallel components, k-out-of-m systems, non-series parallel systems, Systems with mixed mode failures. Standby redundancy: Simple standby system, k-out-of-n standby system.

Unit - III

Maintainability and Availability: Maintainability function, Availability function, Reliability and availability analysis of a two-unit parallel system with repair using Markov model, Reliability and availability analysis of single-unit and two- unit cold standby systems with constant failure and repair rates using regenerative point and supplementary variable techniques. Economics of Reliability Engineering: Manufactures cost, Customers cost, Reliability achievement and utility cost models, Depreciation cost models and availability cost model for parallel system.

Text Books: -

1. E. Balagurusami, Reliability Engineering, Tata McGraw Hill, New Delhi, 1984.
2. L. S. Srinath, Reliability Engineering, Affiliated East West Press, New Delhi, 1991.
3. Elsayed A. Elsayed, Reliability Engineering, Addison Wesley Longman. Inc. Publication
4. A. Birolini, Reliability Engineering: Theory and Practical, Springer-Verlag.
5. Jai Singh Gurjar, Reliability Technology, I.K. International Publishing House Pvt. Ltd.

RAFFLES UNIVERSITY

Japanese Zone, NH-48, Neemrana-301705

Ph.D. Course Work Syllabus

Paper-II Mathematics

(Inventory Management)

Paper Code-(Ph.D.-102)

Contact Hours: 4 Hrs/ week **Continuous Assessment: 40 Marks**

Credit: 4 **End Term Exam: 60 Marks**

Unit - I

Introduction: The Historical Development, Nature and Meaning of Operations Research and its Management Applications. Modelling in Operations Research and its Principles. Approximations and Main Characteristics of Operations Research. General Methods for solving Operations Research Models. Main Phases of Operations Research Study. Scope of Operations Research. Role of Operations Research in Decision-Making. Brief outlines of Operations Research-Models: Quantitative Techniques. Development of Operations Research in India. Role of Computers in Operations Research.

Unit - II

Inventory/Production Management-I (Deterministic Inventory Models): Inventory -Definition, Decisions. Types of Inventory Models and their Development. Costs involved and Variables in Inventory Problems. Deterministic Elementary Inventory Models: Static Demand Models, Dynamic or Fluctuating Demand Models and Deterministic Models with Price-Breaks.

Unit - III

Inventory/Production Management-II (Probabilistic Inventory Models and ABC Analysis): Probabilistic Inventory Models, Selective Inventory Management, Replacement and Reliability Models.

Text Books: -

1. . H. A. Taha, Operations Research-An Introduction, Prentice Hall, 2010.
2. P. K. Gupta and D.S. Hira, Operations Research, S. Chand and Co. Ltd., 2014.
3. S. D. Sharma, Operations Research, Kedar Nath Ram Nath Publications, 2012.
4. J. K. Sharma, Mathematical Models in Operations Research, Tata McGraw-Hill Publishing Company Ltd., 1989.
5. Kanti Swarup, P. K. Gupta and ManMohan, Operations Research, Sultan Chand and Sons, New Delhi, 2014.
6. Ravinderan, Philips and Soleberg, Operations Research-Principles and Practice, John Wiley & Sons, Pvt. Ltd., 2007.